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The Green Economy and Emerging Green Business Models in the Danish Window Industry

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Abstract

Keywords: green business models, eco-innovation, green economy, dynamic capabilities, evolutionary economics, construction, windows

1. Introduction

The concept of green business models is gaining increasing attention with the rising interest into eco-innovation and green growth but there is as yet little consensus about what it entails. This paper contributes to building an understanding of the concept applying a 'dynamic capabilities' perspective (Teece, 1986, 2000, Langlois, 1992, 2002) within a wider evolutionary economic understanding. The paper uses a case study within the window industry to set focus on the emergence and design of green business models. This is an industry which is generally considered to be conservative and little innovative but which is increasingly affected by the rising demand for new energy efficient solutions, buildings accounting for 40 pct. of EU and 32 pct. of world energy consumption (IEA, 2012) and hence an industry which is being strongly influenced by the green economic evolution.

The business model describes how a company brings an innovation to market and capture value from this. The core point of the paper is to view green business models as a generic phenomenon rather than a specific (green) way to organize production. Rather, green business model innovation should be seen as closely related to the emergence of the green economy which we interpret as a pervasive ongoing global techno-economic paradigm change (Andersen, 1999, 2012). This paradigm change has widespread disruptive effects within companies as well as on the market, affecting the business models of companies in pervasive and fundamental ways. However, different types of companies and industries are affected differently by the green economic evolution which is still little analysed (Andersen, 1999, 2006). We argue that given the special properties of eco-innovations identified that lead to extraordinary high dynamic transaction costs (Andersen, 1999, 2012), a key function in green business models is the emphasis on access to complementary assets. The window case supports this claim illustrating how the structure and the nature of coordination in the value chain is changing.

Methodology

The case study is primarily Danish but with international perspectives. The data is based on a series of interviews undertaken from 2009 and onwards mainly with Danish companies or large international companies operating in Denmark, patent data, secondary data, and data from an energy labeling scheme for Danish window. To a minor degree also information from related industries is included, noticeably the important flat glass industry.

The paper first discusses how to understand business models and green business models, then turns to the case of the window industry and finally concludes.

2. Understanding business models and green business models

There are significant challenges involved in bringing innovative ideas to market. This is true for large established corporations and is amplified for small and medium sized businesses who are strapped for resources.

The business model describes how a company creates and captures value based on the value proposition articulated. It has been described as 'a mediator between technology and economic value creation' and is seen as the link between technology change, ensuing innovation and the ability to perform in the market (Amit and Zott 2001; Chesbrough and Rosenbloom 2002; Zott and Amit 2007).

Different business model frameworks exist but they all incorporate some elements of value proposition (product and service offering; identifying a market segment; revenue models) and some element of operating model (defining the structure of the value chain and the position of the firm in this, cost models and organizational change (see e.g. Kiron, 2013). These elements come together to formulate the competitive strategy. Innovation in business models comes from new activities (content), new linkages between activities (structure) and new partners (governance). The dynamic capabilities perspective emphasize how the business model should provide access to the complementary assets that are crucial in helping the company deliver on the given green value proposition (Teece 1986b and 2010; Arora and Ceccagnoli 2006).

Understanding green business models

The literature on green business models is quite small but rapidly growing (e.g Bisgaard et al (2012), Kiron, 2013). It is still, though, not very consolidated and it remains therefore unclear what we understand with green business models.

Most literature on green business models bring examples of radically different business models or provide a case collection of a range of different green business experiences. E.g. Bisgaard et al (2012) propose two main green business models. One is the incentive model which includes functional sales or product service systems and performance-based models which may have green effects such as energy, -water saving and material savings. It also includes chemical management systems and design, build, finance and operation activities geared towards helping users realize sustainable effects. The second model is the life-cycle model which includes cradle to cradle, take back management, green supply chain management, and industrial symbiosis.

This work, like many others in the area which is dominated by consultancy work more than research, lack a theoretical understanding of eco-innovation which could help classify the green business model cases more stringently. They also neglect to link up green business model innovation to the aggregate green economic evolution.

This paper takes a different evolutionary starting point and investigates how the 'greening' of the economy affects different types of firms and industries' business models. Traditionally, environmental sustainability has been considered a burden to business associated with extra costs (Kemp and Andersen, 2004, Andersen, 2009). Since the early 1990s there has been a slow but steady rise of proactive eco-innovation strategies in firms. It is only within the last decade however, that eco-innovation has been recognized as an important driver of economic development (OECD 2011). We argue that the integration of environmental issues into the economic process has now reached a level where we may talk about the emergence of a 'green business model' (Andersen, 2012). We need, however, an understanding of the stage and character of the current green economic evolution in understanding what conditions different types of firms and industries face when trying to attract profits from their eco-innovations.

This is a rather comprehensive discussion which we can only deal with partially here. Our core argument is that there are unusual high dynamic transaction costs to greening due mainly to the inherent normative (it is good to be green), systemic (recycling, LCA perspective and resource efficiency is systemic), and radical (many but not all require changes in heuristics or technological or organisational disruption) nature of eco-innovations and their complexity (due to the systemic nature, changing nature and large scope and connection to technical infrastructures) causing very high information needs (see Andersen, 1999, 2006, 2012). A firm cannot go green alone but needs to bring other firms in the value chain on the same 'green wavelength' as their own in order to attract green rents (Andersen, 1999). Green markets are still only emerging, with lacking information codes and information channels. The lock-in into none green practice and the prevalence of inefficient green markets means that eco-innovation is still far from being the 'easy and natural innovation' (Nelson and Winter, 1982) (Andersen, 1999, 2012). There is therefore a need for exceptionally good business models in order to profit from eco-innovation, which is little recognized.

In analyzing the emergence and design of green business models it is therefore essential to pay attention to the availability and distribution of green capabilities in the value chain and the efficiencies of green markets and their supporting institutions at any given time and place for the given industry or firm (see also Andersen 2012). Over time the transaction costs to greening sink as the green capabilities become more widespread and the green market supporting institutions more established. It matters therefore highly when and under what circumstances different types of industries begin to go green and how uneven the green learning in the value chain is.

Given these characteristics of eco-innovations we argue that the key to successfully commercialize eco-innovations is a business model that emphasizes access to the complementary assets that are needed in helping the company deliver on the given green value proposition.

We define the green business model in the following way: A firm's business model is green when environmental issues make up an important part of the value proposition. Certainly there will be 'weak' and 'strong' green business models depending on how important the green profile is to the competitive strategy of the company. This will also change over time as the opportunities for attracting green rents will continue to undergo changes and the companies will adjust their business models. To talk about a green business model, the environmental dimension has to be sufficiently significant to influence importantly on both the value proposition and the operating model of the firm. Our point is that given the pervasive and paradigmatic nature of the green economic process most companies seeking to go green to some extent are likely to change their business models sooner or later. There is some quantitative evidence that this is the case (Kiron et al, 2013).

3. Eco-innovation and green business models in the window industry

The window industry is an SME dominated industry forming part of the construction sector which is generally considered to be conservative and little innovative and mainly home market oriented. In Denmark there are a range of small window producers, a little less than 300 companies, representing 6000 employees and a turnover of 6 billion DKK and one big dominating group, the *VKR Group*, the green business model of which forms the focus of this case analysis¹.

The evolution of eco-innovation strategies in the window chain started in the flat glass industry dominated by a few multinational companies. Energy efficiency has by far been the main driver. The large R&D intensive flat glass producers. Policies for energy efficiency in windows were introduced already in the 1940s, making double glazing mandatory in new builds in some countries, including Denmark. Soon limitations in the energy emissivity of the glass panes followed and has continued to be strengthened ever since. For the glass producers double glazing was attractive as this meant they could sell double as much glass as normally. They accordingly saw energy efficiency as a business opportunity and adopted early proactive eco-innovation strategies, and started developing important eco-innovations such as advanced coatings for low-emissivity, solar control (reducing the need for ventilation) and less important self-cleaning glass (reducing water and detergents).

The Danish window producers, one step up the value chain entered into eco-innovation strategizing later, mainly in the 1990s and 2000s and still ongoing. The environmental regulation had targeted the glass while ignoring the frame and the sill. Also, following the energy crisis in 1974 the Danish

¹¹ The VKR Group holds one of the strongest global brands in the building materials industry particularly within skylights via the most important company, Velux. It has manufacturing companies in 10 countries, sales companies in almost 40 countries, more than 10,000 employees globally and 2,600 in Denmark.

authorities introduced limitations in the amount of windows that were allowed in new buildings as windows were considered energy inefficient (first time in 1979 and only left out in 2006). This led to defensive strategies among the window producers where the environment was seen as a threat to their business. While the glass had become quite green the window frame had not. Instead, design and maintenance were and still is an important product criterion. Elegant wood-alu windows became popular on the Danish market in the 1990s and remain so up to now despite the fact that they are little energy efficient. Only in 2006 were more flexible 'energy frame' policies directed at the entire energy performance of a building providing stronger incentives and flexibility for eco-innovation among window producers.

Simultaneously, in the second half of the 2000s, the hot climate agenda made energy efficiency a new top political international target and overall the interest into environmental and sustainability policies grew dramatically. Rising novel political talks of green growth strategies and green business opportunities at national and international levels caused a marked change in corporate strategizing in the window industry. There is by now a widespread intensive search for green profit opportunities among the Danish window producers.

Among the leaders in eco-innovation in windows we find the large and quite R&D intensive VKR Holding Group². Patent studies show the leading role VKR has had internationally within green patents in windows, see figure one in appendix 1. They also show the rise of eco-innovative activities in the 1990s, figure 2 in appendix 1. Still, green patenting only make up a smaller part of overall patenting in the global window industry (see annex 1). From the end of the 1990s and up through the 2000s and ongoing VKR Holding is strengthening their eco-innovation. This has had a marked effect on the business model of the company.

First of all, today green competitiveness is an important part of the value proposition of the firm and clearly articulated in company strategies and branding. The firm engages in certified environmental management systems, cradle to cradle eco-design and green supply chain management leading to much more demanding communication with suppliers and customers on environmental issues.

Second, an important reconfiguration of the value chain has taken place by integration upstream related to the core business activities, the window frame production. The small Danish upstart company Superwood from 2002 developed a new patented environmentally friendly method for wood preservation based on nanotechnology (the 'supercritical technology'). In 2006 the company was bought up by VKR. Wood and wood alu frames still make up the standard frame material in the VKR Group, which needs to be able to supply large quantities in a verified quality. Developing more environmentally benign wood (conventional wood preservation products are highly toxic) as well as possible additional quality properties makes it an interesting product innovation. The VKR Group is so far testing the wood and is engaged in further product development serving the specific needs of window production. This action may be seen in relation to other more radical eco-innovations in the frame production undergoing in Denmark. At last we see attempts at developing more energy efficient and durable window frames based on new composite materials. These are being developed both within VKR and, initially, among other smaller or medium incumbent window companies (Fiberline (producing profiles only and not entire windows)

, in a cooperation with the small Danish company Protec. Protec shifted from alu-wood production into composite materials, but due to limited market success as the products are more expensive, the composite production has been decreased again. Also the firm Dovista, belonging to the VKR Group, has recently launched new composite energy efficient windows. Several producers are experimenting with different types of insulation in the window frame in a novel cooperation with the large Danish insulation company Rockwool, who hitherto has not been active on the window market.

Third, the product portfolio has been broadened. While originally specializing in windows the company operates today in 4 business areas: Roof windows & skylights, Vertical windows, Solar thermal energy and Ventilation & indoor climate. None the least the ventilation solutions are seen as a rising eco-innovation business area. Window offers a novel green solution to customers in the form of 'natural ventilation' as an alternative to mechanical ventilation systems. The company, as they state themselves on their webpage, develop and market environmentally sound ventilation solutions for energy efficient buildings, manufacturing both mechanical and natural ventilation systems in companies in five countries and sales companies in nine countries within Western Europe³. While light always has been an important product offering for window producers, it now acquires new dimensions as 'passiv lighting' appears as a new green alternative to electric lighting (which used to be a major energy spender but this has lessened considerable the later years due to the transition from incandescent bulbs to LED technology. Skylights are especially important as a light provider.

Fourth, and most radically, we see an interesting strategic change among the two core companies within the VKR Group, Dovista (vertical windows) and Velux (skylights). These two window producers are increasingly engaged in systemic eco-innovation at the building level. They function as the main actors in several green demo house projects in Denmark and Europe. In this way they are threatening the position of existing architects and construction companies, overtaking a new role as building designers and system integrators on the green building market. The radical shift from window to building producer they do in order to secure important parts of their value proposition. They seek to forward the new concept of the 'active house' as a critique of the reigning German based but internationally recognized low energy 'passive house' concept. The primary aim is to demonstrate that it is possible to build energy efficient houses without compromising on light, indoor climate (in the still tighter energy efficient houses) and the well-being of people. VKR Holding's business model is now based on 'investing in daylight, fresh air and a better environment' and with 'Sustainable living' as a core concept. They are 'producers of light and air' rather than window producers.

In order to fulfil the new product and service offerings of light, air and well-being, they have had to engage in building designs (it is essential to place windows correctly in buildings to optimize the lightning and the ventilation functions) and smart integrative automation systems, e.g. for automatic opening and closure of windows and screens to optimize light and energy control.

Fifth, the cost model has changed as the company engages in still more advanced but also expensive product offerings, to some degree expecting to gain a premium price for the green or sustainable properties of their products.

² This does not mean that VKR is the only or most interesting eco-innovator. Also some of the smaller companies have made important eco-innovations such as Horn Vinduer, producing novel 'ventilation windows' and Protec, engaging in composite window production.

³ See also <http://www.vkr-holding.com/4,-d-,0%20Om%20VKR%20Gruppen.aspx>

Sixth, the firm has invested heavily in extensive green market communication in order to reach out to customers. The EU is currently considering their first energy label on windows in connection to the eco-design action plan. Velux, the core VKR company, has engaged themselves heavily in this labeling process, engaging two people nearly full time the last two years on the project undertaking heavy lobbying. The main purpose of the work is to try to set a standard for how to calculate the energy efficiency of windows. The VKR proposition is to suggest an 'energy balance' calculation based on the combined effect of the energy gain ('g-value') and the energy loss ('u-value'), This is in contrast to the reigning pure u-value calculation practiced in most countries. For VKR as a specialist in skylights but also as a Danish producer where we have considerable light gains in the long Danish summer days, such a calculation method is a main advantage.⁴

The investment includes paying five core window research institutes distributed around Europe to undertake research into the validity of the calculation method suggested by VKR. This underlines an important aspect of business models, which is often neglected, How (bigger) companies may contribute to building market supporting institutions, of particular important related to eco-innovations, and how immensely costly this may be.

The background for this action is the ill-functioning market for energy efficient and green window products. This may explain why there are still many less energy efficient products as well as products with considerable indoor climate problems (problems with condensation) on the Danish and international market. Customer knowledge, even among professional users on windows is very poor. While windows appear as a simple product, they are not, and it is in fact highly difficult to compare the energy efficiency and functionality of competing products.⁵ The Danish market has been fragmented by different energy label systems. The first window energy label systems were made in the mid 1990s in a cooperation between different industrial associations, respectively the glasindustry (a label for thermo- and low e glass), the glacier industry (a label for flyleaf pane) and the window industry (a label for the window). The co-existence of the many voluntary labels have contributed to the confusion, users mixing up glass/pane and windows, and lacking transparency of the market. The window label has been much criticized for not supporting the most energy efficient windows, at one time withdrawn but was relaunched in 2009 and still exists. Despite the critique the label seems to have had an effect on quite many of the smaller producers who have improved the energy performance of their products. The turbulence related to these labels illustrates the inherent information problems related to eco-innovations. Window labels today are national or at best regional. The Nordic Swan label on windows has never taken root with only two licencees after 16 years, partly due to problems with agreeing on common Nordic methods of calculating energy efficiency.

⁴⁴ VKR further suggest to climate zones (north and south), some are suggestion many more, some onlyk one, and a special treatment of skylights due to the very different lightning properties of these windows compared to vertical windows.

⁵ Personal communication, Christian Oxenvad, Energitjenesten, Thomas Kampmann, Danish School of Architecture, May 2013.

4. Conclusions

The paper has argued that green business models should be seen as a generic phenomenon rather than a specific (green) way to organize production such as PSS. Rather, green business models should be seen as closely related to the evolution of the green economy which is likely to affect the business models of companies in fundamental ways. We argue that due to the high transaction costs of eco-innovations in green business models the ability to access complementary assets is especially important. The window case illustrates quite radical green business model innovation, most noticeably how some of the bigger actors in the sector are changing their position in the value chain in order to capture value from their eco-innovations. Accordingly, the structure and the type of relations and coordination of the value chain have undergone considerable change. The analysis undertaken has contributed to a beginning understanding of the specificities of eco-innovation and the related green economic evolution and how this affects green business model innovation in the window industry. Clearly, the difficulty of profiting from eco-innovation has been well illustrated. The analysis points to the need for further attention into how firms can design their business models in order to access the necessary complementary capabilities to profit from eco-innovation, noticeably the need to put further attention into green market formation and how firms green business models should tackle ill-functioning green markets and at times, unfortunate and shifting environmental policies. The conditions for other industries will differ but general aspects of eco-innovation dynamics, noticeably the high green dynamic transaction costs, will be similar.

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Appendix 1 Patenting findings and methodology

Methodology

The database used for the patent search is the Derwent World Patent Index, from Thomson Reuters, covering the period of 1963 to 2013. The search is based on previously chosen keywords⁶ related with green technologies on windows (excluding glass) combined with selected firms' names. The keywords selected define what we call "green patents" on windows.

In the first search, the keywords were combined with the names of 121 selected firm brands extracted from FREEDONIA (2013) that represent the important window producers on the global market for windows and doors. From this sample were selected the firms with two or more patents in the database and conducted additional searches for firms that have a relevant patenting activity on windows but were not included in the initial sample, through searching the same keywords but excluding the 121 firms. Were used also some IPC classes related with windows frames⁷ for an additional search for firms' names. The last step was the search with the final sample of 72 firms⁸ combined with the abovementioned keywords. The final search gave a total number of 756 "green patents" from 1975 to 2013, being reduced to 719 after a manual trial.

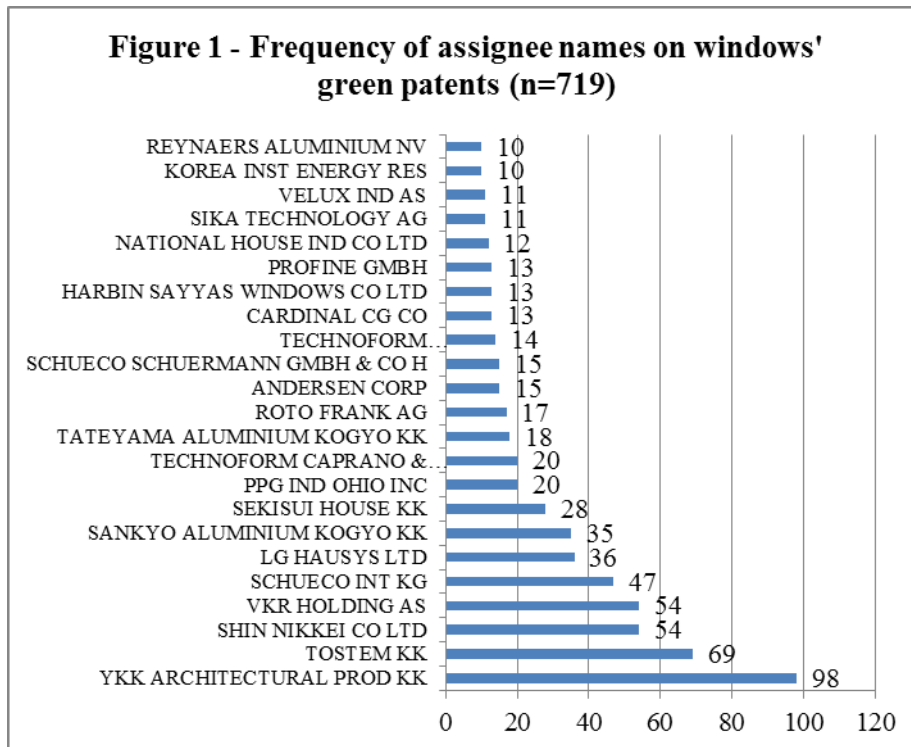
Findings

The frequency of assignee names (Figure 1) on green patents show that the main assignees are the Japanese groups YKK Architectural, Tostem, Shin Nikkei, followed by the Danish VKR Holding and the German Schüco International.

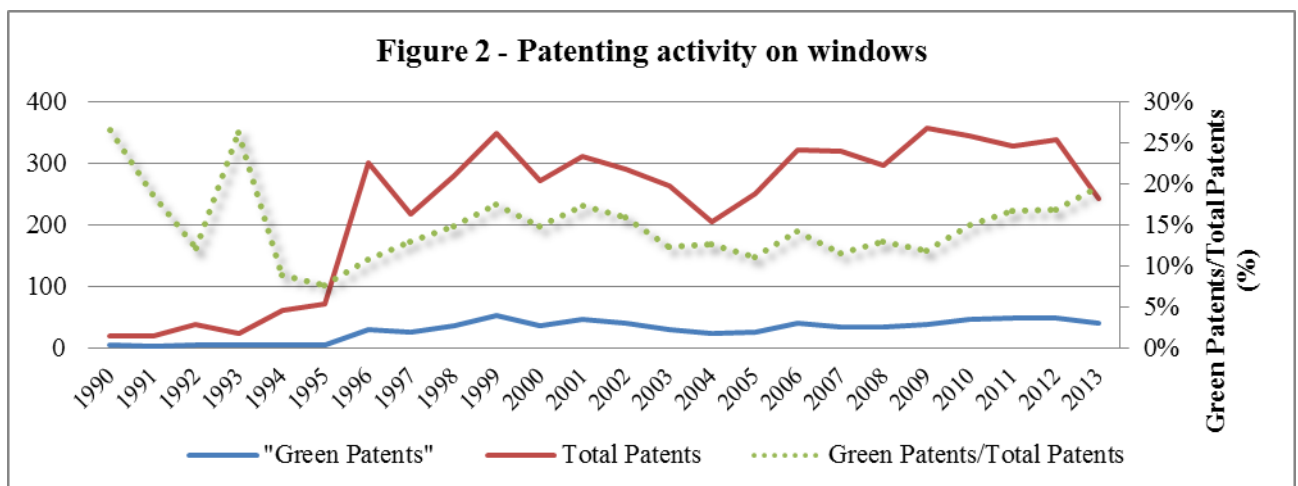
⁶ Keywords: (energy efficient* OR passive ventilation OR double glaz* OR triple glaz* OR smart shutter* OR smart blind* OR smart curtain* OR recyclable OR self-cleaning OR GWP OR argon OR PVC OR automatic OR solar control OR insulati*) AND (window*).

⁷ IPC classes: E06B-003/00 OR E06B-005/00 OR E06B-007/00 OR E06B-001/04.

⁸ Final sample of firms: ASSA ABLOY OR YKK ARCHITECTURAL OR TOSTEM OR VKR holding OR Velux OR ANGLIAN WINDOWS OR VEKA OR THERMA-TRU CORP OR DECEUNINCK OR LG Hausys OR HT TROPLAST OR MASONITE INT CORP OR MILGARD MFG INC OR PROFINE GMBH OR REYNAERS ALUM* OR SHENYANG YUANDA ALUMINIUM IND GROUP OR PELLA CORP OR SANWA OR WEATHER SHIELD OR HARBIN SAYYAS WINDOWS OR SIKA TECHNOLOGY AG OR KOREA INST ENERGY RES OR EHGON WINDOW & DOOR SYSTEM OR CRITTALL WINDOWS LTD OR SHIN NIKKEI OR SANKYO ALUMINIUM OR SEKISUI HOUSE OR ROTO FRANK OR TATEYAMA ALUMINIUM KOGYO OR SCHUECO OR KAJIMA CORP OR NATIONAL HOUSE IND CO LTD OR ANDERSEN CORP OR ALLAN BROS LTD OR ATRIUM CO INC OR CLOPAY OR DURAFLEX LTD OR DYNACO OR EAGLE WINDOW & DOOR INC OR EFCO CORP OR ELITFOENSTER AB OR EMCO ENTERPRISES INC OR GEALAN FENSTER-SYSTEME GMBH OR HOERMANN OR INTEGRITY OR JELD-WEN OR LIXIL CORP OR MARVIN OR MASCO OR NATRE OR NORDAN OR NOVOFERM OR PEACHTREE DOORS INC OR PLY GEM OR RATIONEL OR SILVER LINE BUILDING PROD CORP OR SIMONTON BUILDING PROD INC OR SNE ENTERPRISES INC OR STEGBAR PTY LTD OR TECTON PROD OR WAYNE-DALTON CORP OR RAVENBRICK LLC OR PPG IND OHIO INC OR ECKELT GLAS GMBH OR ERBSLOEH ALUMINIUM GMBH OR ERBSLOEH ALUMINIUM GMBH OR CARDINAL GLASS IND INC OR CARDINAL CG CO OR TECHNOFORM CAPRANO OR LINGEMANN GMBH OR VISIONWALL CORP OR MIKRON IND



According to the data on Figure 2, below the first big movement of patenting on windows frames and structures was on the 1990's (specifically from 1996), when the number of patents increased from 61 patents in 1995 to 261 patents in 1996 and continued around 200-300 patents/year until 2013. This movement was initially pushed by Japanese firms like Tostem, YKK Architectural, Shin Nikkei, among others. The green patents also accompanied this general movement, although their number has shown a relative decrease in the period 2004-2008, though it increased again after this period.



The second wave of green patenting activity seems to be pushed by the European firms. After the first wave, the number of green patents registered on Japanese Patent Office stabilized on a low level, while the number of patents registered at the EPO and USPTO has increased.